# SWITCHING SYSTEMS MANAGEMENT
# CROSSBAR TANDEM SWITCHING SYSTEM
# CAMA AND TSP OPERATION

CONTENTS PAGE



Tables

CONTENTS PAGE



Figures

CONTENTS PAGE



CONTENTS PAGE



## 1. INTRODUCTION

**1.01** This section covers the application of centralized automatic message accounting (CAMA) and the use of the traffic service position (TSP) when added to a XBT-CAMA office. Other basic information describing operation of the XBT may be found in DFMP, Division H, Section 12a, XBT System Description.

**1.02** Whenever this section is reissued, the reason for reissue will be given in this paragraph.

**1.03** In addition to its primary function as a switching facility, the XBT may be arranged to record billing information automatically for multiunit and toll calls. Automatic billing permits customer dialing of these calls from those offices that do not have AMA facilities.

**1.04** The XBT office arranged for TSP operation provides a means of extending customer direct distance dialing (DDD) to include customer dialing of special toll calls, coin distance dialing (coin DD), and local and toll dial assistance as dial zero calls.

## 2. CENTRALIZED AUTOMATIC MESSAGE ACCOUNTING (CAMA) EQUIPMENT

### A. General

**2.01** This description of automatic message accounting (AMA) is limited in this section to that operation and equipment which applies to noncoin 1 + CAMA traffic. On calls from an operator-identified (OI) office, an operator obtains the calling number and keys it into the equipment. On calls from offices equipped with automatic number identification (ANI) equipment, an operator is not required except when troubles are encountered or special services (such as credit card billing, etc) are required on the call. The complete call details are recorded on paper or magnetic tapes, which are then processed into customers' bills at an accounting or electronic data processing (EDP) center.

**2.02** The equipment elements used on an AMA call are shown in Fig. 1. An overall description of the method of operation on a call basis is given in the following paragraphs to indicate the interrelationship of these elements.

### B. AMA Call From a Panel Or Crossbar Office

**2.03** An AMA call from a panel or crossbar office comes into a XBT office over an AMA incoming trunk. This trunk has two main appearances in the office: a trunk link frame appearance used in the talking connection and a sender link frame appearance used for passing information to the common control equipment.

**2.04** As soon as the incoming trunk receives a seizure signal from the originating office, it signals a sender link and controller circuit to obtain a sender (connections 1a and 1b shown in Fig. 1). Information concerning the incoming trunk (AMA call, trunk link frame number, recorder number, etc) is passed to the sender by the sender link and controller. The controller also sets up the connection between the sender and trunk through the link. After the sender has registered the information, it signals the originating office that it is ready to receive the called number.

**2.05** After the sender has registered six digits, it signals its marker connector to seize an idle marker (connections 2a and 2b). The sender then gives the marker the information necessary to select an outgoing trunk and establish a transmission path through the office. The marker selects an idle outgoing trunk (connection 3) and an idle channel (connections 3 and 4) and sets up the connection between the incoming trunk and the outgoing trunk. The marker gives the sender outpulsing instructions and releases, leaving the sender in control of the transmission path.

**2.06** After registration of the incoming digits, the sender link and control circuit send an ANI request signal to the calling office.

**2.07** Calls from ANI offices will be automatically identified if they are originated by individual or 2-party lines. They will be OI if they are originated by 4-party or other multiparty lines or in the event of an identification failure.

**2.08** Since the calling number will be received from the originating office on a multifrequency basis, each XBT dial pulse (DP) and panel call indicator (PCI) sender will have a multifrequency (MF) receiver added externally. An MF sender will use the same MF receiver for registration of the calling and called numbers. After sending the called number in the usual manner, the originating office will send a keypulsing (KP) signal, followed by an information digit on a multifrequency basis. Depending upon the information digit received, the originating office and the XBT sender will function as follows:

- ***Automatic Identification Digit***—The originating office will follow the information digit with the calling number and a start pulse.
- ***Operator Identification Digit***—This digit indicates multiparty customer, and the XBT office will handle the call as it would any other OI call.
- ***Identification Failure Digit***—The XBT office will handle the call as an OI call except that a distinctive order tone will be sent to alert the operator to use a different challenge. In offices arranged for ANI, all CAMA senders, whether or not they are arranged for ANI, must operate with positions arranged for two types of order tones. If the originating office fails to send an information digit, the XBT sender will time for a minimum of 6.5 seconds and then

handle the call as already described for an identification failure.

**2.09** Now the sender signals a transverter connector to seize an idle transverter (connections 6a and 6b). To this transverter, the sender transmits the called and calling numbers and other information necessary for perforating the initial entry on the tape.

**2.10** A CAMA operator will be called in when any of the following irregularities are encountered.

(a) One-out-of-five or three-out-of-five frequencies received in the information digit or in any of the calling number digits.

(b) Less than seven digits received.

(c) More than seven digits received.

(d) Information digit received is not a valid digit.

A transverter trouble record is taken for calls encountering any of these irregularities including an identification failure or no information digit. For all calls, the information digit received will also indicate whether the call is being service-observed in the local office. If no information digit is received, it will be assumed that the call is not being observed in the local office.

**2.11** The transverter is arranged to permit distinguishing between operator and automatic identification calls. If trouble is encountered in the billing indexer or transverter, the sender reorders the operator on an OI call or the marker on an ANI call.

**2.12** The transverter signals its billing indexer connector to obtain a billing indexer (connections 7a and 7b). From information supplied by the transverter, the billing indexer determines the MBI, the calling office index, and the type of initial entry that must be perforated. The billing indexer transmits the above information to the transverter. The transverter then releases the billing indexer and signals the sender to release the CAMA position.

**2.13** The transverter connects to the recorder associated with the incoming trunk through the recorder connector (connections 8a and 8b). Then the transverter transmits the initial entry, one line at a time, to the recorder. Before transmitting the last line, the transverter signals the incoming trunk to identify itself to the recorder through the CII (connections 9 and 10). As the last line is being perforated, the transverter signals the recorder to use the information supplied by the call identity indexer. As soon as the complete initial entry has been perforated, the transverter and recorder release.

**2.14** On some calls, the sender can start outpulsing upon release of the marker or upon the keying of the first digit of the calling number. However, on other calls it must wait for completion of the transverter functions as previously described. The type of distant office is controlling, and more detailed information is given in this section in the part describing the sender.

**2.15** At the completion of outpulsing, the sender releases. The incoming trunk maintains the connection through the trunk and office link frames.

**2.16** When the called party answers and the charge delay interval (2 to 5 seconds) expires, the trunk recalls its recorder through the call identity indexer. The recorder perforates a one-line answer entry and releases. When the calling party disconnects, the recorder is called in again by the trunk to perforate a one-line disconnect entry. At the same time, the connection through the trunk and office link frame is released.

### C. AMA Call From A Step-by-Step Office

**2.17** An AMA call from a step-by-step office comes into the XBT office over a DP AMA incoming trunk. This trunk has three main appearances in the office: a trunk link frame, an incoming register link frame, and a sender link frame. The first appearance is used in the talking connection, while the other two are used for passing information to the common control equipment.

#### 10-Digit Dial Pulse Register

**2.18** A 10-digit DP register associated with MF senders and a data transfer circuit provides a means whereby a customer from a step-by-step office may utilize DDD facilities. The trunk used with this register is arranged for either loop or

E&M lead supervision, usable for either ANI or non-ANI operation.

**2.19** The incoming register link (connections 1c and 1d, Fig. 1) is of a fast bylink type capable of attaching the register to the incoming trunk with such speed that the first digit dialed by the customer into the tandem office is received by the register. The subsequent called number digits are registered by the 10-digit register. All of the called digits are then transferred (connections 1e and 1f) by the data transfer circuit from the register to the MF sender. The register then disconnects and and is available to serve other trunks. After the register disconnects, the operation is similar to that described in panel and crossbar calls in 2.03 through 2.16.

#### 3-Digit Dial Pulse Register

**2.20** As soon as the DP trunk receives a seizure signal from the originating office, it signals the incoming register link to obtain an incoming register and the sender link and controller to obtain a DP sender.

**2.21** The register link obtains a register in time to receive the first digit following the directing prefix. During the registration of the first three digits in the register, a DP sender is attached, which has received information concerning the incoming trunk (AMA call, trunk link frame number, class of service, etc), and the fourth and succeeding digits are registered in the sender via the sender link. The incoming register transfers the first three digits to the sender via the sender-register connector and then releases. After the sender has registered the digits, the operation is similar to that described for panel and crossbar areas in 2.03 through 2.16.

### D. AMA Incoming Trunks

**2.22** An AMA incoming trunk is similar in its switching functions to other XBT trunks. It assists in setting up a talking connection by identifying itself to a marker and maintains the path established by the marker through the trunk and office link frames for the duration of the call. The DP trunks used with the incoming register return a reorder tone to the customer if a register is not attached in time to receive the first digit.

**2.23** An AMA trunk also has charging functions. It identifies itself to an associated recorder through a call identity indexer, it times to distinguish called party answer supervision from flashes, and it controls the recording of answer and disconnect time entries.

**2.24** The various types of trunks which may be used are as follows:

(a) PCI trunks for traffic incoming from panel and crossbar offices.

(b) DP trunk with reverse battery or E&M supervision for traffic from a step-by-step office in a distant building.

(c) A 3-wire DP trunk with sleeve supervision for traffic from a step-by-step office in the same building (OI operation only).

(d) MF trunks from No. 5 crossbar offices and No. 1 crossbar and panel offices equipped with auxiliary senders and from step-by-step common control offices.

**2.25** These trunks have a trunk link frame appearance and a sender link frame appearance. In addition, trunks in (b) and (c) also have appearances on the incoming register link frame.

#### Timed Disconnect Entry

**2.26** Although a call is normally controlled by the calling customer, a connection is not maintained indefinitely through the switches of a tandem office after the called customer has hung up. The trunk starts timing if the called customer disconnects and the calling customer does not. If the calling customer has not disconnected by the end of the time period (13 to 32 seconds), the connection to the outgoing trunk is released and a timed release entry is perforated on the AMA tape. The time release entry causes the AMA center equipment to deduct a time allowance from the elapsed time of the call.

**2.27** At the end of the timing period, the PCI and MF trunks send the called party's disconnect signal to the originating office, which times again. At the end of the timing, the trunk to tandem is released and dial tone is returned to the customer.

**2.28** The DP trunk waits until the disconnect entry has been made and then removes the reversal which was returned when the trunk was seized. The originating office immediately releases the trunk to tandem and returns dial tone to the customer.

**2.29** If a trunk calls for a disconnect entry and the recorder cannot be reached for any reason, the trunk times out in an interval equal to the charge delay interval. It then withdraws its request for the perforation of a disconnect entry and restores to normal. In this case, the call has only one timing entry and the accounting center equipment enters a charge only for the initial period.

#### Abandoned Call

**2.30** A customer may abandon a call after the initial entry is perforated and before the called party answer is recognized by the trunk. Upon abandonment, the trunk restores to normal without causing any further tape perforation. The AMA accounting center equipment disregards the initial entry and no charge is made.

#### Decade Arrangements

**2.31** AMA trunks, like other tandem trunks, are grouped in decades on the sender link frame to permit the sender to obtain information common to 10 trunks on the same switch. The decade arrangement exists at all trunk appearances as follows:

(a) On the main distributing frame (MDF) or intermediate distributing frame (IDF).

(b) On the trunk frame.

(c) On the sender link frame.

(d) On the trunk link frame.

(e) On the call identity indexer frame.

(f) On the trunk test connector frame.

(g) On the incoming register link frame.

**2.32** All the trunks in a decade must meet the following requirements:

(a) Be served by the same recorder.

(b) Have the same rate class. (For CAMA, rate class is used to distinguish divisions of customers within an office to which different charge treatments are applied).

(c) Be connected to the primary switches of the same trunk link frame.

(d) Be connected to the same switch on a register link frame when used.

(e) Be connected to the same primary switch on a sender link frame.

(f) Be associated with the same tens group relay in the call identity indexer.

(g) Be associated with the same vertical of a trunk test connector switch.

#### Reserve Trunks

**2.33** A reserve trunk is a substitute trunk to which the cable conductors are transferred while the regular trunk is being tested. They are used for PCI, ANI, and OI operation and for MF OI operation to avoid the need for calling the originating office to take the regular trunk out of service. Reserve trunks are not required for DP or MF ANI operation since the regular trunk can be made busy at the originating end by sending a reversal from the tandem office.

**2.34** One reserve trunk is required for all trunks served by the same recorder. The trunk automatic test circuit controls the replacement of a service trunk with its associated reserve trunk before the test of the service trunk is begun. The same feature allows the reserve trunks to be associated with the test circuit for testing.

**2.35** Reserve trunks are also arranged in decades; and the decade association persists on the trunk frame, the trunk link frame, and the sender link frame.

**2.36** A decade of reserve trunks has fewer requirements than a decade of service trunks, since some of the information normally pertaining

to a service trunk is supplied by the trunk test frame. All the trunks in a decade of reserve trunks must meet the following requirements:

(a) Be connected to the primary switches of the same trunk link frame.

(b) Be connected to the same primary switch on the sender link frame.

**2.37** A reserve trunk must be associated with the same recorder as the service trunk it replaces. A reserve trunk may serve several different types of service trunk decades; for example, a reserve trunk may serve one decade of service trunks with rate class 0 and another decade of trunks with rate class 1.

**2.38** When a decade of service trunks is not filled, it may be desirable to mount the reserve trunks in the vacant spaces on the service trunk frame rather than on a separate reserve trunk frame. However, if this is done, it will be necessary for both the service and reserve trunks to meet their own decade requirements as stated in 2.36.

## 3. CAMA OPERATION WITH SWITCHBOARD

**3.01** Operator identification (OI) of calling details is required where the originating office does not have ANI equipment, when the sender is handling a call from a 4-party or rural line, or when an ANI call encounters a recording failure. The CAMA switchboard positions for handling OI traffic may be located in the same building with the switching equipment, or they may be located in a distant building.

**3.02** On an OI call, after the called digits have been registered in the sender, a CAMA position is attached, the operator is given order tone, and the talking path between the calling customer and operator is closed. If there is a delay in seizing the CAMA position, audible ringing tone is sent back to the calling customer.

**3.03** The operator obtains the calling number and keys it into the sender on an MF basis. In the case of remote operation of the CAMA switchboard, the digits are keyed into a MF receiver which then passes them into the sender. The sender now has enough information to connect to a transverter.

### A. Information To Transverter

**3.04** The sender requests a transverter through a transverter connector and transmits the following information to it:

(a) Calling number.

(b) Called number—including the area code on a DP or MP call if one was dialed.

(c) Recorder number.

(d) Class of service, if used.

(e) Rate class, if used.

(f) Service observed, sender test, or trunk test indication, if required.

**3.05** After registering this information and other information supplied by the billing indexer, the transverter signals the sender to release the position.

### B. Outpulsing

**3.06** As mentioned previously, the procedure for outpulsing varies with the type of distant office. On calls to panel and crossbar offices (including toll crossbar), outpulsing does not start until the calling number is registered in the sender. Timeout of a distant sender or register is thereby prevented in case the sender has difficulty in obtaining the calling number. On calls to step-by-step offices (including intertoll), since no distant sender or register is involved, outpulsing can start earlier and does so as soon as the marker releases. In all the above cases, outpulsing proceeds up to the units digit. This digit is not outpulsed until the transverter releases, which indicates that all AMA functions are complete, and thereby prevents ringing the called station prematurely.

**3.07** On calls to PCI manual offices, outpulsing does not start until all AMA functions are complete. After the transverter releases, the sender awaits assignment of an operator at the manual office and then outpulses all digits without pause. The operator at the manual office then completes the call.

### C. Position Link

**3.08** The position link provides a maximum of 40 senders with access through a primary-secondary link arrangement to a maximum of 100 CAMA positions. Traffic is distributed on a call distribution basis by two controllers per frame, each of which can simultaneously set up one call at a time. Each link frame serves a different group of 40 senders, but all link frames have access to the same 100 positions. The 40 senders associated with a frame are divided into four groups with two groups preferring one controller and the other two groups preferring the second controller. However, both controllers can serve all four groups; and if one controller attempts but fails to handle a call, the call is given to the mate controller.

**3.09** To ensure equitable distribution of traffic over the switchboard, positions are divided into groups and adjacent positions assigned to different groups. With this arrangement, a controller, in distributing calls over a group, distributes them over separated positions along the switchboard. The division into groups is determined by the ultimate number of positions, with five groups as a minimum and ten groups as a maximum. Each controller of a link frame has access to five position groups.

**3.10** Fig. 2 illustrates an arrangement for an office that has 12 positions equipped and will not exceed 50 positions in the ultimate. For this case, the positions are divided into five position groups (A through E). Position 0 is assigned to appearance 0 in group A, position 1 is assigned to appearance 0 in group B, etc, up to position 4 which is assigned to appearance 0 in group E. The next five positions (5 through 9) are assigned to appearance 1 in groups A through E, respectively. This arrangement continues through all equipped positions and is maintained for all added positions.

**3.11** Fig. 2 also illustrates the sequence with which a controller distributes calls over the switchboard. Assuming the previous call was given to appearance D0 (position 3), the next call is given to appearance C1 (position 7), the next to C0 (position 2), the next to B2 (position 11), and so on in descending order.

**3.12** The above distribution assumes that all positions are idle and that only one controller is hunting for a position. If more than one controller is hunting for a position, the controller with first preference for a group will be the one that hunts over the positions in that group. The other controllers hunt over other groups as determined by a preference chain.

**3.13** When hunting over a group, a controller assigns a call to the preferred position if idle; and if not idle, assigns the call to the first idle position in the descending chain. A call is not assigned to a position within the preferred group if the preferred position and all lower-numbered positions are busy, even though a position above the preferred position is idle. The controller advances to the next preferred group and starts hunting over the group starting with the highest-numbered position. It then continues assigning calls in descending order.

**3.14** When the number of position groups exceeds five, both controllers of a frame cannot reach all positions. For example, Fig. 3 shows the arrangements for six-position groups with 22 positions equipped. Position groups B through F can be reached by controller B of frame 0; position groups A through E can be reached by controller A of frame 0. Controller preference arrangements are such that during light as well as heavy load periods, the calls will be distributed without noticeable inequality.

### D. CAMA Switchboard

**3.15** The CAMA switchboard is of the cordless type consisting of one or more lineups of 2-position sections and a cable-turning section. Fig. 4 is a photograph of a switchboard section and the cable-turning section. The cable-turning section is in the foreground. A maximum of 100 positions may be provided. The CAMA positions may be located at the tandem switching point and at remote operating centers, as shown in Fig. 5 and 6. When the positions are located at the tandem switching point, the calling number is given to the sender on MF pulsing basis. When the positions are located at a remote center, MF pulsing is used with an MF receiver per sender provided at the XBT office.

**3.16** When the CAMA position is located at the tandem switching point, all information to and from the calls waiting circuit is on a dc basis. When the position is at a remote location, the calls waiting circuit is connected to an MF supply. A

CAMA 2-way signaling circuit, which is located at the position end, is associated with an MF receiver. The calls waiting circuit receives dc signals from the outgoing trunks to indicate the number of occupied positions and from the senders to indicate the number of calls waiting. To determine the team size, it sends an MF signal to the signal circuit for each of the three team sizes until a dc signal is returned, indicating that the correct team size has been identified. It then sends an MF signal to indicate whether a red, white, green, or no lamp should be lighted.

**3.17** When there are positions at two or more locations in the same or different buildings, each operating unit is associated with a separate group of senders, position links, and calls waiting circuits. The location does not mean that the senders are split into groups as far as the incoming trunks are concerned, but only that they are assigned to different operating teams.

**3.18** In an emergency, the CAMA switchboard might have to be abandoned. To permit AMA traffic to be handled in this event, an abandoned switchboard key may be provided. The operation of this key causes the sender links to send a non-AMA signal to the senders. The calls are then completed without calling in the operator or AMA equipment. When there is an operating unit at the tandem office, the key will generally be located on the CAMA, toll, or DSA switchboard. When there is no operating unit at the tandem office, the key will be located in the maintenance center.

**3.19** Inasmuch as operation of this key will result in a substantial loss of revenue, it is threaded by a wire loop with a lead seal to disclose unauthorized operation and covered by a guard to prevent inadvertent operation. A guard lamp is lighted and an alarm sounds in the operating room as long as the key is operated. An alarm is also sounded in the maintenance center, but this alarm may be retired and replaced by a guard lamp.

### E. DSA and Toll Switchboards

**3.20** It may be necessary to transfer AMA calls to a cord-type switchboard during light load periods when the cordless switchboard is closed down. At the tandem switching point, connections are available for No. 3C and 3CL toll boards and for No. 13C, 15C, and 15D DSA boards. Similar arrangements are made for No. 3 toll boards, No. 1 toll board with type A cords, and No. 14 DSA boards.

**3.21** Cordboard positions are assigned to the link in the reverse order and start with the last position group and the last position within the group. This facilitates additions in both cordless and cordboard positions.

**3.22** When located at a remote operating center, each cordboard position which is to be used for CAMA operation must be associated with a particular CAMA position. As shown in Fig. 7, an option is provided so that the incoming trunk circuit can be transferred from the regular CAMA position to the cordboard. The cordboard is provided with a call waiting lamp which lights whenever one or more senders are waiting for positions and no position is available. However, this signal is furnished by the calls waiting circuit and is available only when the calls waiting signals are not being used at the CAMA positions, since it is planned that the transfer keys will not be operated while the cordless switchboard is in operation.

### F. Transverter-Connector

**3.23** A transverter-connector connects senders to transverters so that information can be exchanged between these circuits. There are two types of connectors: one for use with PCI senders and one for use with DP and MF senders. All connectors have access to the full transverter group, a maximum of twelve transverters. Each connector can serve nine TSP positions and a maximum of five senders, and each sender appears in only one connector.

**3.24** Within any one connector, only one connection can be made at a time. However, as many simultaneous connections as there are transverters can be made through different connectors.

**3.25** In case of simultaneous demands on a connector by two or more circuits, the circuits take their turn as determined by their relative positions in a sender preference circuit.

**3.26** The transverters are arranged in a definite order by a chain circuit in each connector. If the first choice transverter is busy, then the first idle transverter in the order of preference is selected. If all transverters are busy, the connectors

take their turn depending upon the relative position which each connector has in the transverter preference chain.

**3.27** If a transverter fails to complete its functions and times out, it gives a trouble release signal to the connector. The connector releases the transverter and makes a second trial by seizing another transverter or the same transverter if all others are busy. If this second transverter encounters trouble, the call is handled free if it can be identified as a MU call. If it is a TS call or one that cannot be identified, it is routed to reorder.

### G. Transverter

**3.28** The major functions of a transverter are to register, translate, and convert the information received from the sender and billing indexer to a form or pattern satisfactory for recording, and then transmit to a recorder all the information necessary for the initial entry of a call. This is the only entry for which the services of the transverter are required; the answer and disconnect entries are made under control of the trunk and call identity indexer.

**3.29** The transverter is provided with options that permit it to handle traffic that originates and terminates in one area, traffic that originates in more than one area and terminates in only one area, and traffic that originates in one or more areas and terminates in more than one area. The area indication is passed to the billing indexer for use in connection with the charge for the call.

**3.30** Regardless of the number of terminating areas, the transverter can refer only three (home area and two foreign areas) to the billing indexer as areas for which the billing indexer must determine information for bulk-billing purposes. The remaining areas must be areas for which all calls receive TS billing.

**3.31** Another function of the transverter is to seize the line observing number matching circuit. This circuit signals the transverter to make detailed tape records of AMA calls originated from particular subscriber lines when detailed records are desired for various reasons, such as customer charge complaints. The transverter seizes the line observing circuits at the time the transverter is connected to the sender. Information between the two circuits is passed directly and not through the connector.

### H. Sender and Billing Indexer

**3.32** After connection to the sender, the transverter receives the following information:

(a) Calling number.

(b) Called area code, if necessary.

(c) Called number.

(d) Rate class, if required.

(e) Recorder number.

(f) Class of service, if required.

(g) Trunk test, sender test, or service observing indication, if required.

(h) ANI or non-ANI code.

**3.33** The transverter uses all but the rate class in performing its functions. The rate class plus the calling office code and the called office code are passed to the billing indexer. The transverter also determines the terminating area when interarea traffic is served and passes the terminating area indication to the billing indexer. Although the transverter controls the recording and uses the recorder number to select the proper recorder, the recorder number is required by the billing indexer for other purposes, and it is passed on by the transverter.

**3.34** The billing indexer performs its functions and passes to the transverter the calling office index, the type of initial entry to be made (MU, MUD, or toll), and the message billing index. After the complete information is received and it is checked as satisfactory, the transverter sends a release signal to the sender and a release signal to the billing indexer.

### I. Recorder and Call Identity Indexer

**3.35** The recorder is called for and the initial entry information is perforated on the tape one line at a time in the proper sequence. MU calls are perforated in two lines, MUD and TS calls in four or five lines.

**3.36** The transverter may be arranged to perforate a maximum of ten 3-digit area codes as single digits on 4-line entries. If more than ten areas are reached, the remaining area codes are perforated as three digits on 5-line entries. However, the three areas to which either bulk-billed or TS calls can be made must be areas for which the area codes are perforated as single digits on 4-line entries.

**3.37** At about the time the recorder is seized, the transverter signals the call identity indexer to get ready to identify the incoming trunk. As the last line of the initial entry is being perforated, the call identity indexer furnishes this trunk number to the recorder. With the initial entry completed, the transverter signals the recorder that the initial entry is complete. This signal is relayed from the recorder to the trunk and tells the trunk that the call should be charged for if answered.

**3.38** If the transverter is unable to complete the initial entry after two attempts, a bulk-billed (MU or MUD) call is switched through without charge and a detail-billed (toll) call is routed to reorder. If the call cannot be identified by the billing indexer as a MU call, it is treated as a toll call and routed to reorder.

**3.39** In rare instances, a recorder may be plugged busy and the emergency recorder may not be available. The transverter recognizes this condition as soon as the recorder number is given by the sender. Disposition of the call awaits completion of billing indexer functions. Second trial by the transverter-connector is made on a bulk-billed call. If on this second attempt a recorder cannot be obtained, the call is handled free. A routing to reorder is made on toll calls without making a second trial.

**3.40** If a recorder is associated with the master timer for the 3 AM entry during the early stages of perforating this entry, or if the recorder is perforating a splice pattern, the transverter recognizes this condition and the call is handled as described in 3.39. If the recorder is requested during the later stages of the 3 AM entry, a signal is given to the transverter which then temporarily extends the timing to wait for the recorder.

### J. Billing Indexer

**3.41** The billing indexer has functions other than that indicated by its name and must be supplied even when every call is billed by toll statement. In addition to determining the billing index, other major duties of the billing indexer are the determination of an office index and of the type of initial entry. It also checks the originating office code against the recorder number to determine that the code given is assigned to the recorder, and it checks the originating office code against the called office code to determine whether the customer gave the operator the called rather than the calling number.

**3.42** The billing indexer deals only with a transverter and, depending upon the call, receives all or some of the following information:

(a) Originating office code.

(b) Rate class, if required.

(c) Recorder number.

(d) Terminating area number.

(e) Terminating office code.

#### Determination of Billing Index

**3.43** In local AMA offices, the MBI is relatively easy to obtain as it is practically a function of the terminating office. At the XBT the complexity of obtaining this index is multiplied by the number of originating offices, by their varying rate classes, and in some cases by office codes duplicated in two or more originating areas.

**3.44** Because calls from different originating offices to the same called office may receive different charge treatment, the tandem billing indexer must first determine which one of the originating offices is making the call and then apply an originating rate treatment. Similarly, since many called offices may be reached and the charges for calls to these offices may not be the same, the billing indexer must determine which office is being called and then apply a terminating rate treatment. A combination of an originating rate treatment and a terminating rate treatment determines the MBI for the call.

**Originating Rate Treatment**

**3.45** All originating offices, for which identical charges can be applied on like calls, form an originating rate treatment group and receive the same originating rate treatment at tandem. The originating rate treatment will be the same for all calling customers in an office provided they are all charged the same for like calls.

**3.46** If there are subdivisions of customers within an originating office who are not charged the same for like calls, they are assigned to one of three rate classes and their calls are routed to tandem over different trunk groups. A maximum of 80 originating offices may have two or three subdivisions of customers who receive different originating rate treatment at tandem.

**3.47** Identical originating rate treatment may be given to customers in several different offices regardless of their rate class provided they are charged the same for like calls. For example, customers in rate class 0 in office A and customers in rate class 1 in office B can receive the same originating rate treatment at tandem.

**3.48** If the CAMA office serves originating offices in more than one originating area (a maximum of three areas is possible), there may be as many as three originating offices with the same code but never more than one code per area. The billing indexer can resolve a maximum of ten such code conflicts. To resolve these codes, the originating office code is cross-connected (D) to the code conflict fields where separation by originating area is made. The arbitrary area number (0, 1, or 2) is obtained from the recorder group number cross-connection (P) which, in turn, is obtained from the recorder number cross-connection (V).

**Terminating Rate Treatment**

**3.49** As mentioned previously, the MBI is based on both an originating and a terminating rate treatment. The terminating rate treatment is obtained more simply.

**3.50** The billing indexer is provided with three terminating office code fields, each containing a maximum of 800 code points representing called offices in different terminating areas. Calls to these offices may be either bulk-billed or detail-billed, and the billing indexer must determine which applies for each call.

**3.51** A terminating office code point is cross-connected to one of the 75 terminating rate treatment terminals. Here, in association with an originating rate treatment, a combined rate treatment is obtained.

**3.52** Cross-connection is run from a combination rate treatment terminal to the MBI terminal. Billing indexes 1 through 8 and 10 through 13 are used for MU calls, and 9 is used for toll calls. Billing index 0, used for test calls, is obtained directly from the terminating office code field by means of cross-connection. Offices arranged with TSPs have 30 MBIs available.

**3.53** If all calls to an area are TS calls, the transverter recognizes the area as not being one of the three areas for which the billing indexer determines the bulk-billing information. For these calls, the transverter signals the billing indexer that the terminating area is completely toll and the billing indexer furnishes MBI9.

**Determination of Office Index and Type of Initial Entry**

**3.54** The second of the two originating office code fields is used in the determination of the calling office index and the type of initial entry. The originating office code alone determines the office index which is the same for all calls from an office. Both the originating office code and the MBI for the call being handled are needed to determine the type of initial entry. A particular MBI does not necessarily mean that the same type of entry is made for different originating offices; flexibility is provided as described in the following paragraphs.

**3.55** When there are no code conflicts involved, cross-connection is made from the code point to a recorder group terminal. Here the billing indexer makes a check of the calling office code against the recorder group number. If the office code is one that is not assigned to the recorder group, the operator is given reorder or the call is routed to reorder if it is an ANI call. If the code is assigned to the recorder group, the office index and type of initial entry are determined through cross-connection to the office index initial entry combination terminals.

**3.56** After placing the code in the correct area, the billing indexer checks the code against the recorder group number, cross-connection (R). If the code is one assigned to the recorder group, the office indexer indication is obtained. If the code is one not assigned to the recorder group, a wrong office indication is obtained and the CAMA operator is given reorder; or the call is routed to reorder on an ANI type call.

**3.57** In some instances, several originating offices may be assigned to unfilled recorders that are primarily associated with originating offices in another area. This action may be taken when most of the originating offices are in one area, and it is desired to serve a few offices in one or two other areas without increasing the number of recorder groups. Since the recorder group number provides the billing indexer with the area number and area numbers are compared in order to determine whether to make or skip match check, the correct area numbers must be determined. An area transfer feature, through cross-connections, permits transferring area numbers to the correct area. A maximum of 12 offices may be put in the recorder groups assigned to area 0 or 2 and be transferred to area 1 by the billing indexer. A maximum of six other offices may be put in the recorder groups assigned to area 0 or 1 and be transferred to area 2.

#### Screening of Misdirected Non-CAMA Calls

**3.58** In the billing indexer, the originating offices are assigned originating rate treatments (ORT) and the terminating offices are assigned terminating rate treatments (TRT). Each combination of an ORT and a TRT is associated with a combined rate treatment (CRT) terminal. For multiunit and toll traffic calls the CRT terminals are cross-connected to MBI terminals. When free calls are misdirected into the billing indexer, the CRT terminal is cross-connected to a local call intercept (LCI) terminal which will result in the call being routed to a recorder announcement trunk or to a reorder trunk depending upon a cross-connection in the marker.

**3.59** If all of the CAMA traffic through the XBT office to a particular terminating area is recorded on a toll basis, the offices in this area are not at present associated with TRT. The transverter recognizes all calls to this area as toll calls and MBI 9 is assigned. If LCI is required for any office in this area, all terminating offices in the area must be assigned TRT. The CRT terminals for calls which are to be screened will be cross-connected to LCI and calls which are permitted will be cross-connected to MBI 9.

**3.60** In XBT offices handling only toll traffic, no ORT or TRT is required at present, and the billing indexer is not equipped for them. If the LCI feature is required, all originating offices must be assigned ORT and all terminating offices in areas having points which can be reached on a noncharge basis must be assigned TRT. The basic billing indexer frame may be equipped for 33 ORT, 58 TRT, and for one terminating area. If additional rate treatments are required, or additional terminating areas are involved, a supplementary frame must be added. This frame may be equipped for 17 ORT, 17 TRT, and 2 additional areas.

### K. Call Identity Indexer

**3.61** The call identity indexer performs connecting functions between a recorder and the 100 trunks (maximum) assigned to a recorder and supplies the 2-digit CII (trunk number) for the initial, answer, and disconnect entries.

**3.62** For initial entries, the call identity indexer is signaled by the transverter (through the transverter connector, sender link, and trunk) to identify the trunk to the recorder.

**3.63** For answer and disconnect entries, since the transverter has released, the incoming trunk requests the services of the recorder by closing a path between the recorder and the call identity indexer.

**3.64** For answer and disconnect entries, the call identity indexer has lockout features which permit the serving of a trunk while locking out other trunks requesting the recorder for answer and disconnect entries. This feature is not necessary for initial entries since only the transverter that has seized the associated recorder can signal the particular trunk and call identity indexer to request identification.

**3.65** The call identity indexer uses the same circuit as the indexers for No. 1 and 5 crossbar local AMA, but equipment arrangements are different. The call identity indexer frame for tandem is a single-bay frame with a capacity for 4-call identity

indexer units. Thus, 5 indexer frames are required for an office with 20 recorders.

### L. Recorder

**3.66** The recorder, in conjunction with an associated perforator, transfers the information needed for billing purposes to the paper tape. The recorder operates in response to a transverter in making initial entries on the tape and in response to the call identity indexer in making answer and disconnect entries. Certain other entries are made under the control of the master timer. The master timer has first preference, the transverter second, and the call identity indexer third.

**3.67** Upon being engaged by the master timer, call identity indexer, or transverter, the recorder operates perforator magnets as directed by the circuit in control. The recorder operates the perforator stepping magnets as each line is perforated and also checks the operation of the perforator magnets.

**3.68** Under control of the master timer, the recorder registers (on rotary selectors) the time in minutes and tenths of minutes past the hour and causes a record of the time in minutes and tenths to be placed on the tape at the beginning and at the end of the conversation period as directed by the trunk and call identity indexer.

**3.69** At the start of each hour, the recorder places an hour entry on the tape, and at 3 AM, the recorder enters an end-of-tape pattern. These entries are made under the control of the master timer.

**3.70** An emergency recorder is provided which may be substituted for any of the regular recorders (20 maximum). The substitution is made by inserting a make-busy plug into the transfer jack of the regular recorder. Prior to the transfer being effected, the master timer causes the end-of-tape pattern to be placed on the tapes of both the regular and emergency recorders. This procedure is repeated when the regular recorder is returned to service in order for a record of the transfer to appear on both tapes. The record on the emergency tape includes the number of the regular recorder for which the substitution is made.

**3.71** A recorder may be associated with a maximum of 100 AMA trunks. For PCI or MF non-ANI, the recorder includes the reserve trunks. All of these trunks must be associated with the same call identity indexer. As mentioned earlier, all service trunks in a decade must be assigned to the same recorder.

**3.72** No more than 30 office designations may be assigned to the same recorder. For accounting reasons, these 30 names appear in a recorder group. One recorder may constitute a recorder group. However, the trunks may be divided between two recorders assigned to the same recorder group, if required.

**3.73** The recorder frame used for tandem AMA is a single-bay frame with capacity for four recorder units. Each recorder unit operates with the full transverter group. Even-numbered recorders are associated with the even master timer; odd-numbered recorders and the emergency recorder are associated with the odd timer.

### M. Perforator

**3.74** The perforator cabinet is a single-sided steel enclosure. Two perforators are mounted in the upper part the cabinet. The paper supply bins and the motor-driven takeup reels for the perforated tape are located in the lower portion of the cabinet.

**3.75** The paper tape is supplied to the perforators in folded form from the supply bins. There are two such bins per perforator, each holding about 3000 feet of folded paper. The two bins are located one above the other so that the bottom end of the paper tape in the top bin can be spliced to the top end of the paper in the lower bin. In this way, a total of 6000 feet of tape is available to each perforator without renewing the supply. In practice, a second carton of paper is introduced after the top one is exhausted. At that time, the lower bin is shifted to the upper position, and a fresh carton is inserted in the second bin, the lower position, and the two lengths of tape are spliced together.

**3.76** Reels for taking up the perforated tape are motor-driven and are under control of a switch which is actuated by a movable arm in contact with the paper tape. When the output from the perforator reaches a certain amount, the motor starts, the reel rotates until the slack in the tape is taken up, and then the motor stops.

**3.77** A maximum of 11 perforator cabinets, housing 20 regular and one emergency perforator, may be furnished for an office.

### N. Master Timer

**3.78** The master timing circuit is composed of an odd and even master timer of the synchronous motor type. The master timer frame is a single-bay frame on which both timers are mounted.

**3.79** One of the functions of a timer is to supply a pulse every 1 or 6 seconds (1 second-timing is standard) to all recorders. This operation can be performed by either timer, and the one selected for this function becomes the control timer. Transfer arrangements allow this and other functions to be assumed by the other timer in the event of trouble.

**3.80** The answer and disconnect time entries entered on the tapes by the recorders and associated perforators are determined by the setting of three selectors provided in each recorder. One of these selectors is advanced every 1 or 6 seconds by the pulse from the control master timer, and it, in turn, controls the others. At 1-minute intervals, the control timer makes a check of the other timer and all recorders for synchronism. An alarm sounds if any timer is out of synchronism, and it is brought into synchronism by maintenance force operation.

**3.81** At the start of each hour, the master timing frame supplies the recorders with hour information for entry on the tapes. At 3 AM, an end-of-tape pattern is placed on each recorder tape under the control of the master timing frame; the odd master timer controls the odd recorders, and the even master timer the even recorders. The end-of-tape pattern includes the month, day, hour, recorder number, and recorder group number. It also contains a special pattern defining where the tape is to be cut for transmittal to the accounting center for processing.

**3.82** In addition to the above functions, the master timing frame is arranged to test certain features of recorders and perforators. These tests are under the control of the odd master timer.

## 4. XBT-CAMA WITH TSP

### A. General

**4.01** TSP operation with XBT is a means for extending customer DDD to include customer dialing of special toll calls, such as coin DD, and local and toll dial assistance originated as dial zero calls. Operator assistance is needed on these calls to aid in their completion, to assume recording correct charge data in the CAMA equipment, and to supervise coin deposits on calls originated at coin stations. Special toll calls include person-to-person calls, collect calls, credit card calls, charge to third telephone calls, time and charge requests, and requests to notify the customer upon the expiration of the initial charge period.

**4.02** Operator assistance on special toll calls and coin DD is furnished at cordless switchboard positions which are bridged on dialed connections. The bridged association is held only long enough to provide required assistance or is locked on for the duration of a call, if needed. The cordless position is equipped with three operator loops which serve as mechanical equivalent of cord pairs of a conventional cord switchboard. Two calls can be locked to the position while the third loop is available to handle another call.

**4.03** The provision of automatic call distribution (ACD), AMA, automatic rating and charge computing on coin calls, and automatic do-it-yourself training equipment mechanizes many of the operator functions. The XBT-CAMA equipment can be arranged to provide TSPs in the same building, which contains the XBT equipment (local positions), or all or some of the TSPs can be installed in a different building (remote positions).

**4.04** A relatively small proportion of outward toll calls require unusual special equipment and special operating procedures for their completion. Such calls include conference calls, appointment calls, sequence calls, and mobile and marine calls which involve the use of radio terminals. Although these typical residual toll calls are originated by dialing zero and are directed to the TSP, the answering operator promptly transfers them to a cord switchboard. Ultimately, when all cord switchboards have been replaced, it will be necessary to handle the small volume of residual toll calls at special groups of TSPs. Special group of TSPs will avoid the expense of furnishing special equipment

at many positions and of training large teams of operators in the handling of complex calls which occur infrequently.

**4.05** This section is concerned primarily with a general description of customer dialing of special toll calls and coin DD by way of XBT equipped for CAMA operation and TSPs. Brief summaries of both XBT and AMA are given in Section 960-310-100 of Bell System Practices. These existing facilities are used for completing noncoin, customer-dialed, paid station calls (1+ 7- or 10-digit called numbers). New units of equipment are required for handling customer-dialed special toll calls (0+ 7- or 10-digit called number), local and toll dial assistance calls (dial 0), and coin DD. Some of the existing XBT-CAMA units require minor modifications to provide for these new customer services.

**4.06** New features provided with XBT-CAMA equipment permit receiving calls from local panel, crossbar, and step-by-step offices. In addition to dial zero assistance traffic from coin and noncoin stations, the new facilities handle the following operations:

(a) Coin and noncoin special toll 0+ calls and coin paid station 1+ calls on which the called number is outpulsed on a MF pulsing basis from panel and crossbar offices and on a DP basis from step-by-step offices.

(b) ANI, when equipped, which uses MF pulsing from all types of local offices.

**4.07** OI, noncoin paid station, 1+ calls can be handled at TSPs rather than at CAMA positions. In other cases, present CAMA switchboards will be retained with cordboard transfer arrangements for night or other light load periods. Alternatively, the CAMA night traffic can be transferred to TSPs.

### B. Switching Plan

**4.08** Fig. 8 shows the basic switching plan of a XBT-CAMA system equipped with TSPs. Incoming trunks and delayed call trunks appear on the trunk link frame. These trunks can be connected to any outgoing trunk by way of one of several paths or channels through the trunk and office link frames. To establish this path and other required connections, the trunk calls for the services of common control equipments (senders, markers, TSP link, data transfer, and others), each of which is called into service for a relatively short time. Each common element performs its function, releases, and is then free to service other waiting calls. A number of the functions performed are as follows:

(a) Store the incoming DP or MF pulse digits as they are received

(b) Translate the called area and/or office code digits

(c) Test for and select an idle outgoing trunk

(d) Test for and select an idle channel

(e) Outpulse, if required

(f) Connect a TSP position, when needed

(g) Connect an automatic coin rater, when required

(h) Connect an automatic charge computer, when needed.

**4.09** Dial zero calls will be transferred promptly from the TSP to a cordboard for special handling. This transfer may be accomplished by a trunk finder or by switching the dial zero call through the tandem trunk and office link frames by keying 3-digit codes.

**4.10** The delayed call trunk is arranged to complete two connections through the XBT office under the sole control of a TSP operator. One of the connections is to an outgoing toll switching trunk to reach an originating customer, and the other connection is through an outgoing trunk to reach a called customer. By possessing the facility for reaching two customers, the delayed call trunk permits the TSP operator to complete a call on a delayed basis—on a subsequent attempt after the calling party has been released.

### C. Used for TSP Operation

**4.11** Fig. 8 indicates basic XBT elements by the use of double lines to outline blocks and conventions for connectors and links. The basic circuit and equipment elements are as follows:

Trunk link frame  CAMA position link

| | |
|---|---|
| Office link frame | Call identity indexer |
| Marker | Recorder |
| Marker connector | Master timer |
| Sender | Billing indexer |
| Sender link | Transverter |
| | Transverter connector |

**Trunks and Associated Circuits**

**4.12** Trunk circuits are those required for handling coin and noncoin dial zero calls, special toll 0+ calls, and for handling coin paid station 1+ calls. A timer link and controller associated with coin 0+ trunks provides regularly recurring timing pulses from a common source. The pulses are stored in a trunk during conversation to measure the duration of a chargeable call.

**4.13** A delayed call trunk allotter is associated with delayed call trunks to permit assignment to operator loops of a TSP when required for completing a call at a customer's request after the call is released.

**4.14** A step-by-step type trunk finder is used with coin and noncoin dial zero trunks to allow a small number of special dial zero calls to be transferred to a cordboard. The trunk finder is activated to perform this transfer function by a single key operation by the answering TSP operator. Eventually the special toll calls will be extended to cord switchboards by keying 3-digit codes at the TSP.

**TSP Units**

**4.15** TSPs are furnished in groups classified as chief operator units, each unit having a maximum capacity of 66 positions, which is the capacity of a link group. A total of five chief operator units (and five groups) can be provided at a XBT installation. Basic circuits required for the TSP are the position control and the position circuits. These provide for local operation with the XBT switching system. When a TSP is located in a distant building remote from the one which houses the XBT equipment, it is necessary to add four circuits as shown in Fig. 8. The four circuits are arranged to interchange momentary and steady state dc signals and digital information in MF form between the crossbar equipments and the remote position over five outside plant pairs per position. All of the TSPs of a particular chief operator unit (link group) must be in the same location, local or remote.

**TSP Link**

**4.16** Calls received over trunks from local offices are distributed to positions automatically in an equitable manner through the use of a new 3-stage crossbar link and associated control circuits.

**Data Transfer**

**4.17** The data transfer circuit is, in effect, a large multiconductor 4-bus common control unit designed to permit the exchange of digital information between different XBT and TSP units. Fig. 8 indicates that such transfer of data can be made among trunks, TSPs, MF senders, 10-digit DP registers, raters, and charge computers. One data transfer circuit is furnished for each tandem office.

**Rater**

**4.18** The rater is a unit for determining a rate treatment number which can be identified with specific rates for a particular coin call. The number reflects distance as determined from the calling and called numbers for a group of terminating areas selected to represent high call volumes. Since the rater has a limited capacity, only the nearby terminating areas and those where a single rate applies for the entire area can be accommodated. In addition to this rating function, the rater provides indications when a vacant code is dialed in error or when a call to an infrequently dialed point must be rated manually by the operator. Each tandem office has capacity for two raters.

**Rate Calendar**

**4.19** The rate calendar associated with the rater shifts the output of the rater to provide rate treatment numbers which not only reflect distance but time with respect to the application of full or reduced rates for day, evening and night, and for Sundays and holidays. Two rate calendars are furnished at each tandem.

### Charge Computer

**4.20** The charge computer used with coin DD performs arithmetic operations to produce a charge for a particular initial or overtime period. The amount is computed automatically from a unique rate treatment number and the length of conversation. A CAMA tandem has capacity for two charge computers.

### 10-Digit Register and Register Link

**4.21** Present XBT-CAMA offices provide 3-digit DP registers, an associated crossbar single-stage link, and a fast-operating relay-type bylink. The 3-digit register transmits its output to a DP sender by way of a sender-register connector. A 10-digit DP register and a large capacity single-stage link is used in XBT offices equipped with TSPs. The output of the 10-digit register is transmitted to an MF sender by way of the data transfer circuit.

## D. AMA Features of TSP Operation

### General

**4.22** This description of AMA is limited to that operation and equipment which is associated with the TSP. A description of the operation and equipment required for CAMA operation, which is a prerequisite for TSP operation, is covered in Part 3. In general, AMA entries for calls handled at the TSP are similar to those made for customer dialed calls made without operator assistance. However, distinctive MBIs are used to identify the calls handled at the TSP.

### Tape Entries

**4.23** On all AMA calls which are completed through the TSP, three tape entries are perforated in the following order:

(a) An initial entry (four or five lines) when the start timing (ST TMG) key is operated.

(b) An answer entry on a station call when the called party anwers or on a person or collect call when the ST TMG key is operated. On all coin calls, the answer entry is perforated when operator releases position.

(c) A disconnect entry when the calling party disconnects. On coin calls, when calling party disconnects or flashes or when called party hangs up.

**4.24** A MUD or toll initial entry, consisting of four lines, is made for MU calls which are completed through the TSP on an operator assistance basis. A detailed initial entry, consisting of four or five lines, is made on all other calls which are handled at the TSP. The 4-line entry is used when the called area is identified by a single digit. The 4-line entry can only be used on home area calls and on calls to nine other numbering plan areas. On all other calls, a 5-line entry must be made in which all three digits of the called area are recorded.

**4.25** Answer and disconnect entries are similar to those used in other applications of AMA. They contain the time in minutes tens, minutes units, and tenths of minutes. They also contain the CII.

**4.26** A cancel entry will be used to cause the AMA center to disregard the answer and initial entries preceding it. It will be used in cases where the operator, believing the proper party has been reached, starts timing and later discovers that the desired party has not been reached.

## E. TSP Operation

### General

**4.27** With TSP operation the operator controls switching and charging functions but does no actual switching and very little charge recording. Instead, all switching and most charge recording is done by the XBT equipment. The operator is bridged on during the initial and subsequent intervals of the call only as required, or the operator may be bridged on for the entire call. In the latter case, if it is not necessary to devote full time to the held call, the operator can serve other calls.

**4.28** The TSP is a 2-position console at which the operators sit. Each position consists of a writing and bulletin shelf. Beyond this is a slightly sloping control key shelf, surmounted by a sharply sloping display panel. Centered in this panel is a 10-digit numerical display using Nixie tubes. These will display calling and called numbers, coin money and minutes, or coin rate treatment as required. Designations identifying the coin displays are illuminated when appropriate. The

display panel includes storage bins for mark-sense tickets and a 24-hour, drum-type clock.

**4.29** Calls are distributed automatically to idle TSP operators. A single zip order tone, which by a wiring option can be transmitted to the calling customer, indicates that a call has been connected to an operator position. The kind of call lamps under DDD and DIAL 0, together with the numerical display in some cases, advise the operator of the kind of call connected.

**4.30** All calls, except CAMA, are connected to the position via one of three loops. Each loop is equipped with an initial period timer and associated control key and key-lamp, called and calling supervisory lamps, and two key-lamps designated ACS (access) and HOLD. The ACS lamp lights to show which of the three loops the positional equipment and the telephone circuit are connected to at the time. Only one loop can be in the access condition at one time.

**4.31** On most calls the position is released as soon as the operator functions are completed. In some cases, however, it will be necessary for the operator to retain supervision of the call; eg, to time and ticket, quote time and charges, or notify. By depressing the HOLD key before releasing, a call is held on the position while freeing the operator to handle other calls. The lamp lights as a reminder that a call is on hold. The operator returns to the held call by operating the ACS key, provided no other loop is in the access condition. The ACS key-lamps are interlocked so that only one loop can be in the access (talk) condition at a time.

**4.32** Although the term "loop" implies that the transmission path between the calling and called customers goes through the position when it is connected, that is not the case. The operator is simply bridged on the connection, and the telephone circuit is designed to introduce negligible loss between customers while providing satisfactory transmission between the operator and the customers.

#### Trouble Recording

**4.33** If a trouble is encountered on a call other than CAMA, the TSP operator can cause a record to be perforated by the trouble recorder. The record will include all the available information on the call plus a code to indicate the operator's interpretation of the trouble.

#### Observing Facilities

**4.34** Observing facilities for XBT equipped with TSPs will be quite similar to those furnished for XBT CAMA. Differences in equipment are necessary due to the larger variety of incoming trunks which are also more complex than CAMA trunks. Some of the pertinent call details recorded on AMA tape are taken from the TSP circuit rather than from MF senders as with CAMA observing arrangements. Delayed call trunks are not arranged for service observing. Incoming trunks have jack appearances at the service observing patch panel as for CAMA trunks.

## 5. NETWORK MEASURING FACILITIES

### A. General

#### Maintenance Registers

**5.01** The following maintenance registers are available in a XBT:

***Sender Link and Controller***

(a) Trouble—1 per controller circuit.

(b) Link False Start—1 per controller circuit.

***Senders***

(a) Partial Dial—1 per DP or RP sender group.

(b) Awaiting Registration—1 per RP or MF sender group.

(c) Awaiting Dialing—1 per RP sender group.

(d) Stuck Sender—1 per sender group per type of outpulsing for the DP and MF.

(e) CAMA-type senders—1 per sender group for all other senders.

**Network Administration Registers**

**5.02** The following network administration registers are available:

***Peg Count***

(a) Trunk Link Frame—1 per frame for each type of sender.

(b) Marker—1 per marker.

(c) Office Link Frame—1 per pair of office link frames.

(d) Outgoing Trunk Group—1 per trunk group where traffic separation is provided.

(e) Traffic Separation—10 per marker.

(f) Partial Digits—1 per DP or MF sender group.

(g) Permanent Signal—1 per MF sender group.

(h) Awaiting Registration—1 per MF sender group.

(i) Revertive Pulse Reorder—maximum of 2 per marker group.

(j) Foreign Area Translator—1 per foreign area.

***Overflow***

(a) Trunk Link Frame—1 per frame.

(b) Office Link Frame—1 per pair of office link frames.

(c) Outgoing Trunk Group—1 per trunk group.

***Group Busy***

Sender—1 per group of senders.

***Load Registers***

Sender—1 per group of senders or 1 per group of 80 or less senders.

**Traffic Usage Recorder**

**5.03** The traffic usage recorder is a measuring facility used in obtaining traffic load information on the following circuits:

Incoming Trunks

Outgoing Trunks

2-way Trunks

Trunk Links

Office Links

Sender Links

Senders

Markers

**5.04** The traffic load is measured by making repeated scannings of the busy test terminals for the circuits under study. The number busy is scored cumulatively. At the end of any period of time, the average traffic load carried can be determined by taking a count of the number of scans and of the total number of busy conditions. A detailed description of the traffic usage recorder is given in Section 951-510-100 of Bell System Practices and in DFMP, Division H, Section 1e(1).

**B. XBT-CAMA**

**5.05** In addition to the measuring facilities provided for regular non-AMA XBT offices, connections to the following facilities are available:

(a) All incoming registers busy—1 per group of 10 incoming registers.

(b) No sender attached—1 per group of 10 incoming registers.

(c) Permanent signal—1 per group of 10 incoming registers.

(d) Partial digits—1 per incoming register group.

(e) Incoming register peg count—1 per group of 10 incoming registers.

(f) Sender group busy—1 per sender group.

(g) Partial digits register—1 per sender group.

(h) Sender load register—1 per group of 20, 40, or 80 PCI, DP, and MF senders.

(i) No position attached—1 per office.

(j) Position peg count—1 per position.

(k) Transverter peg count—1 per transverter group.

(l) Free call peg count—1 per transverter group.

(m) Wrong calling code count—1 per transverter group.

(n) Call count process control—2 per recorder.

(o) Answering time recorder—1 per office.

(p) Holding time recorder—as required.

**5.06** The free call peg count register is scored by a transverter if the transverter cannot complete the initial entry for a bulk-billed call and the call is allowed to advance.

**5.07** The wrong calling code peg count register is scored under several conditions, namely:

(a) If a billing indexer determines that a vacant calling office code was given by the customer or identified by ANI.

(b) If a billing indexer determines that a nonvacant but wrong calling office code was given by the calling customer or identified by ANI.

(c) If a billing indexer determines by match check that the called office code was given in error by the calling customer.

**5.08** Call count process control is a means of keeping an account of the calls or messages at various stages, beginning at the CAMA tandem office and extending through the AMA center. For this purpose, two registers per recorder are provided at the CAMA office. Each is to be used on alternate days with the transfer from one register to the other being made at 3 AM. The register is scored for each completed initial entry and test call perforated on the recorder tapes.

## C. CAMA-TSP

**5.09** Traffic registers are located in the terminal room register cabinet, an operating room register cabinet, or multipled in both locations as specified. The operating room cabinet, similar to ED-92645-01, is furnished on the basis of one for each chief operator unit (maximum of 66 positions). A capacity of 90 registers is provided. Traffic registers discussed are in addition to those normally furnished in a XBT-CAMA office.

### Traffic Service Position Register

**5.10** One register for each position is furnished in the operating room cabinet. Each register counts all of the calls of all types handled at the position, except base rate toll, vacant code, and free calls which use the position momentarily but do not involve the operator.

### Registers Per Chief Operator Unit

**5.11** A chief operator unit is a unit of up to 66 positions also called a link group. Each link group is served by a maximum of 3 controllers. The registers are located in the traffic register cabinet unless otherwise specified. (See Table A.)

### Registers Common to the Tandem Office

**5.12** The following traffic register located in the traffic register cabinet with key control are provided for 10-digit DP registers, raters, computers, and the data transfer circuit.

(a) 10-digit registers—per register group

Peg count
No sender attached*
Group busy time
Initial 1 (count of register seizures on 11X service code calls)

(b) 10-digit registers—per office

Partial dial†

(c) Coin rater—per rater

Rater seizure
Position seizure

(d) Computer—per computer

End of initial period notify
Overtime period

(e) Data transfer circuit

A 1-peg count register is furnished for each data group. The total of 10 registers provides counts to assist in balancing traffic among data groups.

*Multiple on sender make-busy frame

†Calls that score the partial dial register should not score the corresponding register associated with the senders.

The register (NPA) which is scored by the sender when it is unable to connect to a position for a regular CAMA call should be retained, but its use should be confined to regular CAMA calls. Traffic measurement is covered in more detail in DFMP, Div. H, Sec. 12e(2),Traffic Measurements-Register Operation.

## 6. MAINTENANCE FEATURES OF XBT

### A. General

**6.01** The basic provisions for maintenance of XBT offices consist of the following:

(a) Testing equipment for the various circuits and associated apparatus

(b) Arrangements for providing notice of and information about failures occurring on service and test calls

(c) Means for removing equipment from service

(d) Access arrangements for setting up to particular circuits or for selecting circuits in sequence

In addition, testing equipment is provided for testing trunks originating or terminating in other buildings.

### B. XBT-CAMA

**6.02** If poor transmission is experienced on a CAMA trunk, the operator will key a preselected NXX code plus four other digits into the sender in place of the calling subscriber's number. Recognition of the code will cause either a trouble record, trouble indication, or trouble card to be made, depending on the system involved. Each of these will indicate the number of the trunk in trouble, the recorder number to which the trunk is assigned, the special code which the operator keyed, and other pertinent information. The call will finally be routed to reorder or announcement. Transverter trouble register peg counts, second trial attempt features, and the AMA entry are cancelled on this type of call. The special code used should be of the local office area code type. It should be determined locally and should be distinctive so that it is easily recognizable by the maintenance force.

**6.03** In addition to the usual facilities for the maintenance of XBT offices, two maintenance frames are provided for offices with CAMA features. An automatic trunk test frame is provided for testing all AMA trunks. A sender test frame is provided for testing all types of senders and can also be used for testing local positions, transverters, and incoming registers.

### C. CAMA-TSP

**6.04** Maintenance frames and test circuits for XBT offices equipped with CAMA features are as follows:

(a) An automatic trunk test frame

(b) A sender test frame—also used for testing CAMA positions, transverters, and incoming registers and billing indexers

(c) Trouble indicator facilities for the transverter, billing indexer, recorder, and master timer circuits

(d) A test circuit to routinize recorders—the test circuit is provided in the master timer.

**6.05** The testing arrangements listed above are modified to provide for testing the new XBT circuits furnished for operation with TSPs. In addition to CAMA 1+ trunks, new special toll 0+ and dial assistance 0 trunks must be tested. Test facilities are provided for new local and remote TSP and directly associated circuits. Associated circuits include the TSP link and connector, the data transfer circuit, rater, and charge computer circuits.

**6.06** Tandems arranged for TSP operation must be equipped with a trouble recorder. It is expected that when an existing tandem using trouble indicators is modified for TSP operation, the circuits using the indicators will be transferred to the recorder.

## 7. REFERENCES

### *Bell System Practices*

Section 817-010-100

Section 817-102-150

Section 951-510-100

Section 960-110-100

Section 960-310-100

Section 960-320-100

### *Dial Facilities Management Practices*

### *Division H*

Section 1e(1)

Section 12a

Section 12d(3)

Section 12d(6)

Section 12e(2)

### *Drawings*

SD-25435-01 Key Sheet

TABLE A

| REGISTER | BASIS FOR PROVISION | KEY CONTROL | NOTE |
|---|---|---|---|
| Total CAMA calls | 1 per 10 pos | yes | — |
| Total calls connected to position (except CAMA) | 1 per controller | yes | — |
| Noncoin 0+ calls (Class 0) | 1 per controller | yes | 1 |
| Coin 0+ and 1+ initial deposit calls (Class 1) | 1 per controller | yes | 1 |
| Coin 0+ and 1+ Subsequent action calls (Class 1 priority) | 1 per controller | yes | 1 |
| Noncoin 0 initial position seizure calls (Class 2) | 1 per controller | yes | 1 |
| Noncoin 0 position recalls (Class 2 priority) | 1 per controller | yes | 1 |
| Coin 0 initial position seizure calls (Class 3) | 1 per controller | yes | 1 |
| Coin 0 position recalls (Class 3 priority) | 1 per controller | yes | 1 |
| CAMA overlap calls | 2 per chief operator unit | 1 yes<br>1 no | 2 |
| Delayed call trunk seizure | 1 per controller | yes | — |
| Controlled pulsing circuit peg count-inpulsing | 1 per cct | yes | — |
| Controlled pulsing circuit peg count-outpulsing | 1 per cct | yes | — |
| Position display circuit peg count | 1 per cct | no | 3 |
| Data transfer peg count | 1 per data group | yes | — |

*Note 1:* Classes shown in parentheses suggest typical assignment of call classes in the controller.

*Note 2:* A multiple of this register, not key controlled, is located in the operating room register cabinet.

*Note 3:* This circuit is located in the operating room register cabinet at the remote location.

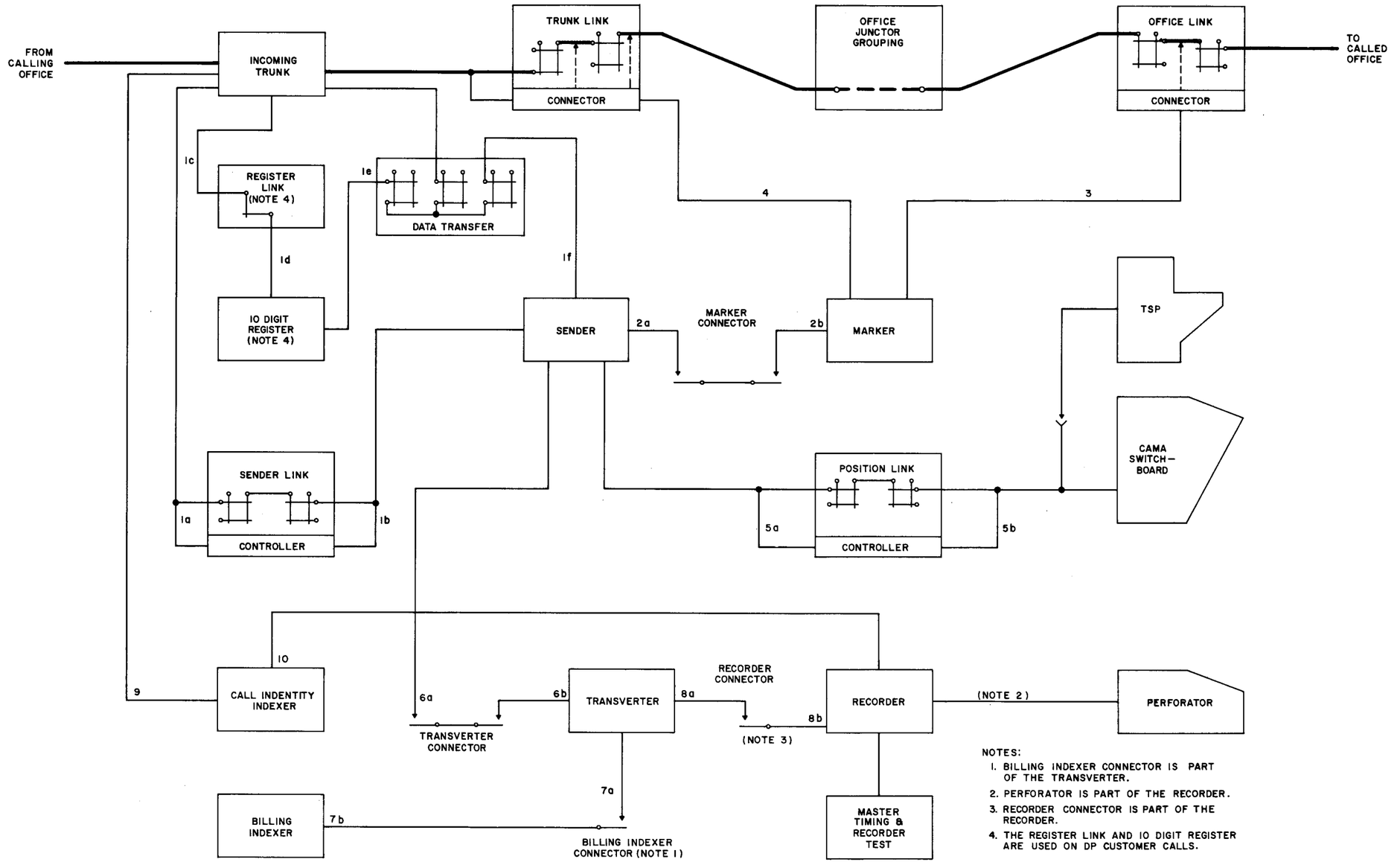
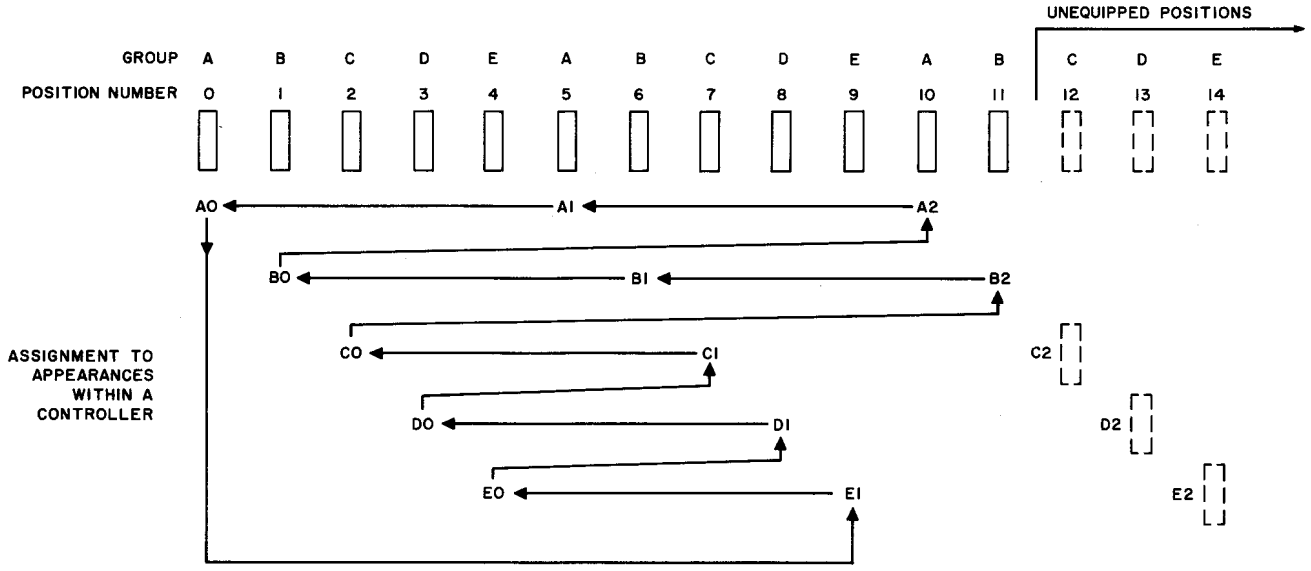


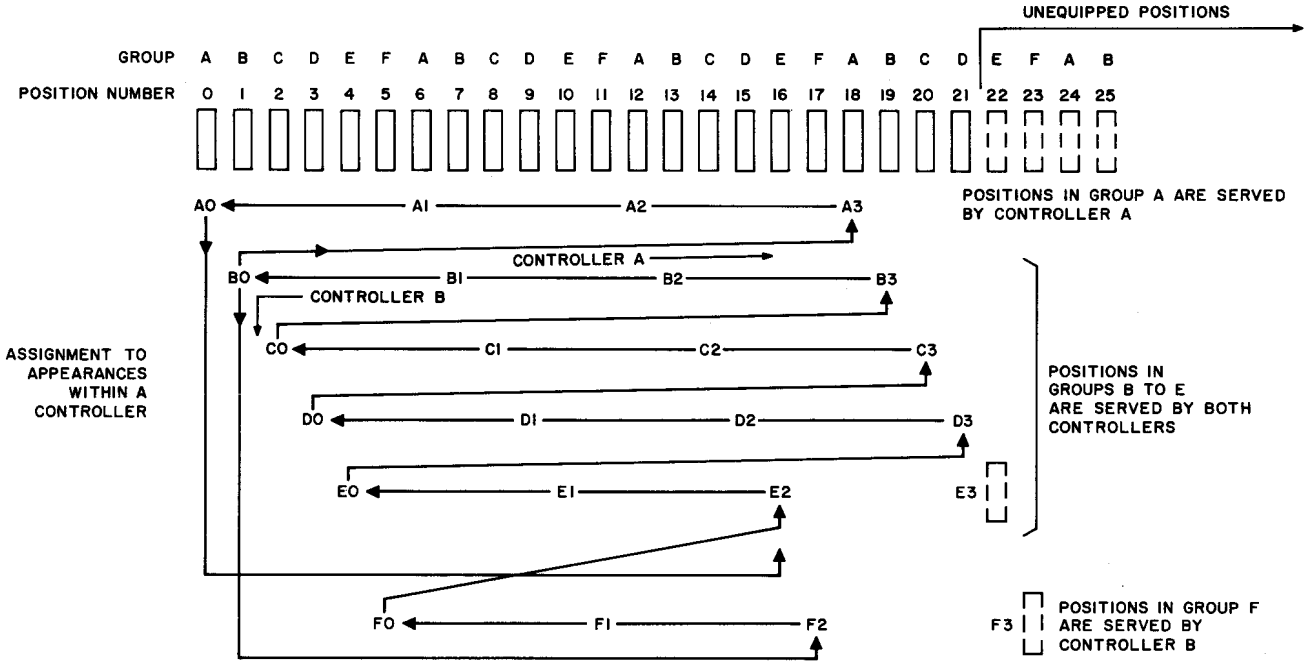

**Fig. 1—Circuits Associated With a XBT-AMA Call**




NOTES:

1. 5 POSITION GROUPS — A TO E.
2. 12 POSITIONS EQUIPPED.

**Fig. 2—Distribution of Calls to Positions—Five Position Groups**




NOTES:

1. 6 POSITION GROUPS — A TO F.
2. 22 POSITIONS EQUIPPED.
3. FRAME O ILLUSTRATED.

**Fig. 3—Distribution of Calls to Positions—Six Position Groups**

Fig. 4—CAMA Switchboard

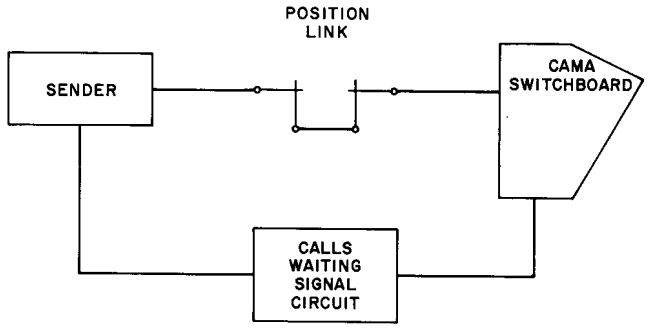



**Fig. 5—CAMA Switchboard at the XBT Switching Point**

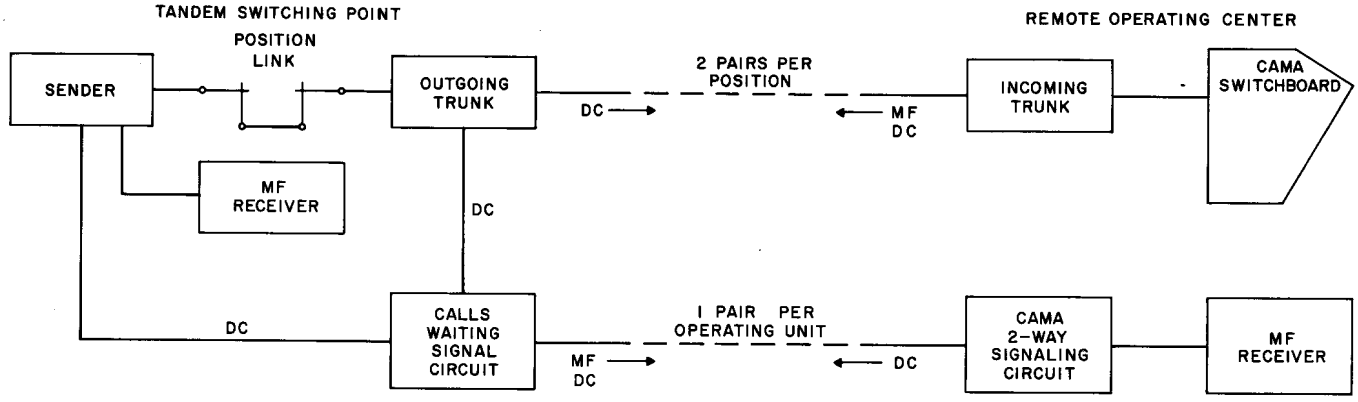



**Fig. 6—CAMA Switchboard at a Remote Location**

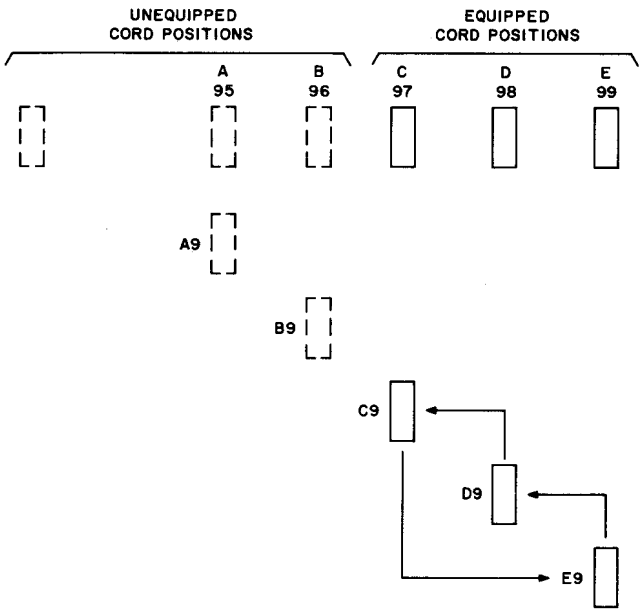



**Fig. 7—Distribution of Calls to Cordboard Positions at the Tandem Switching Point**

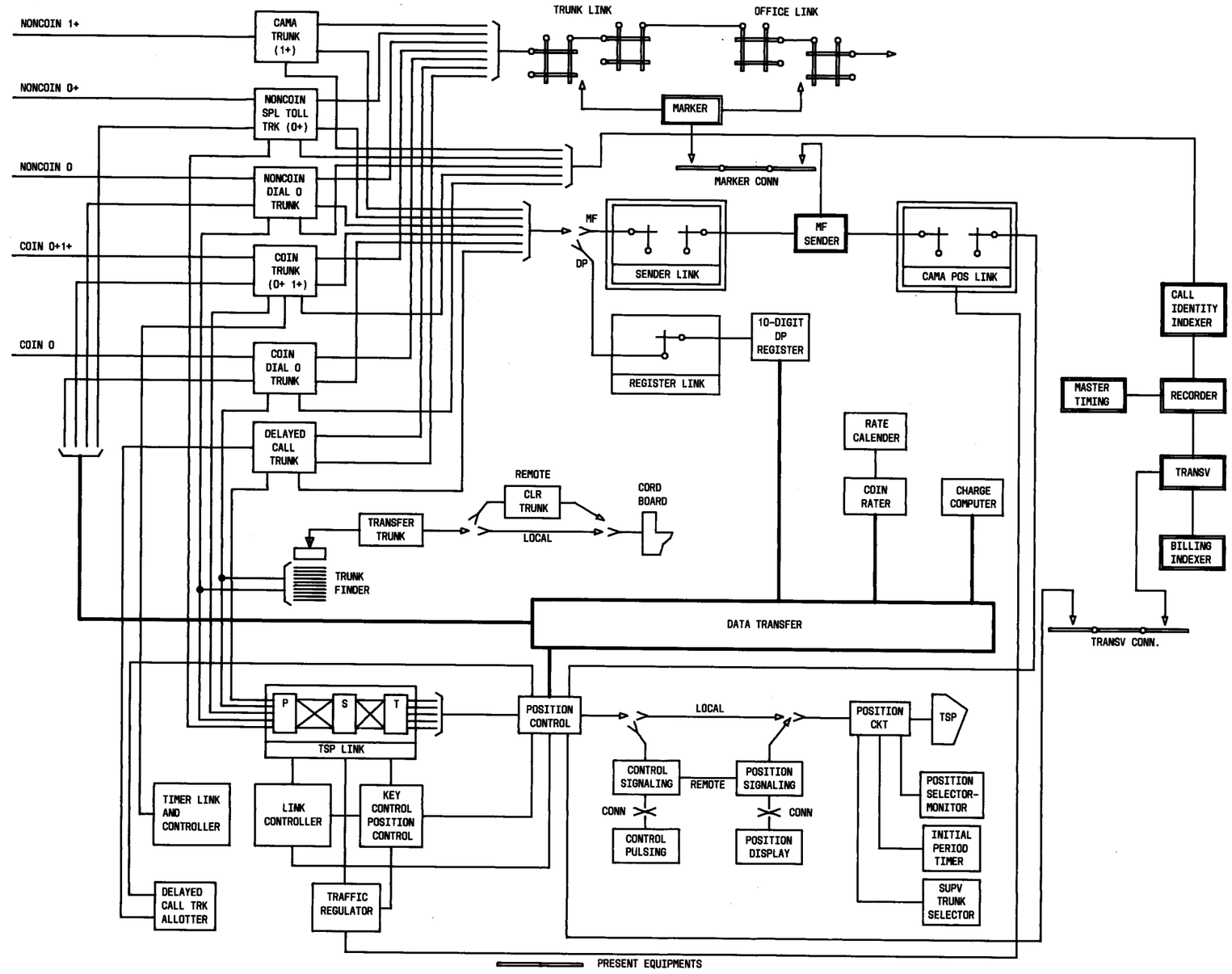



**Fig. 8—System Block Diagram of CAMA/TSP**